As for the third mass which was formed within the sporoblast, it is destined to furnish the plasma of the spore; at a very early stage we find in it two nuclei generally close together, which persist until maturity. Now did these two nuclei preexist within the sporoblast, which in that case would primarily contain four of them, or do they result from the division of a single nucleus, as must be the case if we admit with Bütschli that the sporoblast contains three nuclei only? This is the point which my observations have not enabled me to determine.

Up to this point the spores are rounded or oblong; they lose no time in assuming their final shape by surrounding themselves with an envelope, the origin of which has unfortunately escaped me. In the tailed spores the tail is at first bent back on one side of the spore, and remains in this position until the rupture of the envelope of the primitive sphere, which persists for a tolerably long time.

It is not unusual, especially in the tench, to meet with spores with from three to eight capsules. I have always found a nucleus corresponding with each one of these; their formation therefore probably takes place in the usual way. In this case the sporoblast must without doubt have contained an abnormal number of nuclei; sometimes indeed it seems probable that a single spore is formed at the expense of the primitive sphere.

In conclusion, we may sum up the chief results of my investigations as follows:—

1. The nucleus of Myxosporidia divides by karyokinesis.
2. The polar capsules are formed at the expense of little masses of plasma, which are differentiated within the sporoblast and contain a nucleus; the process of their formation presents many points of analogy with that which has been observed by Bedot * in the nematoblasts of species of *Velella* and *Physalia*.
3. The plasmic mass of the spore is derived from another portion of the sporoblast; it contains two nuclei and a vacuole with contents stainable reddish brown by iodine, the existence of which I have already described, and the presence or absence of which is constant in the same form.—*Comptes Rendus*, cxi. (Nov. 1890), pp. 692–695.

On the Sense of Smell in Starfish. By M. Henri Prouho.

It is a legitimate conclusion from our knowledge of the anatomy of Starfish that the sense of sight is not sufficiently developed in these animals to enable them to distinguish and come up with their prey, and we are naturally led to admit that the sense of smell is their sole guide in the search for food. Nevertheless I have thought it worth while to render our knowledge of this subject more certain, by means of a few experiments directed towards the following points:—(1) observing how the behaviour of a Starfish is affected by the conditions under which prey is offered to it; (2) demonstrating the uselessness of the organ of vision in the search for food; (3) determining whether the sense of smell is diffused or localized in certain organs. The whole of my observations have been made upon specimens of *Asterias glacialis* which have been kept for a year in the aquarium of the Arago laboratory.

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* Bedot, "Recherches sur les cellules urticantes," Recueil zoologique Suisse, 1888.

(1) *a.* An *Asterias* having been isolated in a perfectly clean tub, we wait until it is quite motionless and its ambulacral tentacles, which are of no use for locomotion, near the oculiform spot, retracted; we shall designate these tentacles palps. When this condition of perfect immobility has lasted for some time we place a dead fish at about 50 centimetres from the *Asterias*. After a very short interval (thirty seconds to one minute) the palps nearest to the fish straighten out and the extremity of the arm carrying them is raised; this is the first indication that the Starfish has detected the presence of the bait. Precisely the same movements take place at the extremity of the other arms, and we then see the stimulus starting from the extremity, communicating itself by degrees to the ambulacral tentacles surrounding the mouth. The Starfish begins to move towards the fish. Some individuals go straight towards the bait, others hesitate a few moments. When the Starfish is on the point of seizing the fish I remove it and place it at a short distance from the arm which is posterior with reference to the direction in which the animal is travelling. Carried away by the motion which it has acquired, the Starfish then appears to avoid the bait; but its action soon changes, and we see it retracing its path towards the new centre of attraction. In this way, for a certain time, we can attract some individuals in all directions; but at length the animal becomes so much excited that it is incapable of directing itself with certainty.

b. Precisely the same phenomena are observed when we present a living fish to the *Asterias*; and if we suspend this fish at the distance of the length of the arms of the Starfish from the bottom of the vessel, the Starfish succeeds in seizing it: it rolls one of its arms round the fish, and, hauling on this, it raises itself and applies its mouth to its prey.

We are therefore led to conclude, from careful observation of an *Asterias* excited by a bait, that the sensations which it obeys are felt by the extremity of its arms, at which point a delicate sensibility was long ago declared to exist. Is the animal guided by sight when it advances towards its prey? The following experiments will furnish the answer.

(2) *c.* I removed the eye-spots from four of the arms of an *Asterias*, leaving the adjoining palps as far as possible untouched; and I saw this *Asterias* advance towards its prey with precision, but in such a way that its single intact arm pointed in the opposite direction to that in which the animal was moving.

d. A tub is divided into two compartments by means of a board placed at about 3 millimetres from the bottom. In one of the compartments I place an *Asterias*, and when it is perfectly motionless I place in the other division a dead fish. I then cause a gentle current of water to flow from the fish towards the division in which the Starfish is; the latter immediately manifests the peculiar excitement noticed in observation *a.* It extends its palps and commences to move towards its invisible prey; then, on arriving at the division which separates it from the bait, it attempts to thrust one of its arms beneath the obstacle. Thereupon I raise the board a little; the Starfish at once takes advantage of this; with much labour it stretches its arm beneath the board and seizes the fish placed on the other side.

It thus becomes evident that the very rudimentary organ of vision does not help the *Asterias* in seeking its food, and that the sense of smell alone serves as its guide.

e. Into a tub containing a stationary *Asterias* we let fall, without disturbing the water, a few drops of sea-water in which a fragment of fish has been crushed; the *Asterias* manifests the same excitement and goes through the same movements as if the fish itself had been presented to it.

(3) *f.* I cut off the four distal ossicles of the five arms of an *Asterias*, so as to deprive the animal of all its palps. To-day more than a month has elapsed since the operation, and I have never been able to obtain from this *Asterias* the slightest show of excitement on presenting to it a bait either dead or alive, although before being operated upon the animal was very active in seeking its prey.

g. I removed all the palps of an *Asterias*, leaving the eye-spots. This animal, which in a trial experiment had been quick enough in seizing a linen bag containing a morsel of fish, no longer exhibits excitement on the approach of a bait; and when food is placed in the tub in which it lives with other specimens of *Asterias glacialis*, it alone remains absolutely motionless.

These experiments prove that in Starfish the sense of smell is not diffused, but is localized in the ambulacral tentacles unfitted for locomotion, situated behind the eye-spot.

h. We divide the ambulacral nerves of the five arms of an *Asterias* at about 2 centimetres from the tip, so as to isolate in each arm a distal portion carrying not only the palps, but also a small number of ambulacral tentacles. When a bait is offered to this *Asterias* its palps are at once erected, and the stimulus is rapidly transmitted to the ambulacral tentacles of the distal extremities, but stops abruptly opposite the point where the nerve was divided. The result is that while the tips of the arms, which are powerfully excited, endeavour to set the *Asterias* in motion, the rest of the body, not receiving the sensations experienced by the tactile organs, remains absolutely impassive. This state of things had been foreseen, since we had severed the principal channel of nervous communication between the palps, alone capable of appreciating odours, and the great majority of the motile organs of the *Asterias.* I say the principal channel, for the superficial nerve-plexus has also to be reckoned with. We must conclude, however, that it plays a very subordinate part in the transmission of odours, since I only once saw the *Asterias* which had been operated upon set itself in motion after having been solicited by its extremities for a quarter of an hour; and even then it did not travel towards the bait.—*Archives de Zoologie expérimentale et générale*, sér. 2, t. viii., Année 1890, no. 4, pp. xxxvi–xxxviii (*Comptes Rendus*, cx. (1890), pp. 1343–1346).